THEORETICAL FOUNDATIONS OF THE IMPLEMENTATION OF VOCATIONAL EDUCATION OF FUTURE ENGINEERS FROM PHYSICS

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Abstract*. In this article, the role of physics in the development of professional training of future engineers in technical higher education institutions is mentioned. In the article, unified approaches have been developed that allow choosing the content of the physics course, aimed at developing methods of professional activity of students of a certain technical direction. The professional activity of a bachelor in a certain field of education was analyzed, the specified types of professional activity were summarized according to the goal and the final product, and the method of professional activity, consisting of a sequence of interrelated actions, was determined.*
Keywords: *technique, mechanics, magnetism, analysis, optics, dispersion, diffraction, standard, quantum, etc.*

Physics is the basis of technology, and it has been determined that there are great opportunities to teach students to solve problems that are important for their professional activities. It is necessary to take into account the future professional activity when creating educational goals, choosing content, teaching methods and organizing the educational process. The relevance of the problem of the professional direction of the physics course in the technical areas of education is due to the increasing demands placed on graduates by employers.

We will consider the main directions of the implementation of the principle of professional orientation in the training of engineers. A large amount of research has been devoted to the problem of improving the training of specialists in technical higher education institutions.

The concept of the principle of professional orientation of the educational process in higher educational institutions was introduced into didactics for the first time by R.A. Nizomov and A.V. Barabanshikov and others. R.A. Nizomov considers the professional direction of the educational process to be a unique principle of higher education didactics. However, the basis of the principle appeared later in the works of A. Ya. Kudryavtsev. A. Ya. Kudryavtsev shows the main differences between the principle of practical orientation and the general principle of connecting theory with practice. In his opinion, the main content of the principle of practical orientation "represents the need for a harmonious combination of general and professional education and is aimed at the purposeful preparation of students in the application of the system of knowledge acquired in their profession." The author emphasizes that the main means of implementation of this principle is the consideration of interdisciplinary relations between educational and general engineering subjects. At the same time, professional orientation determines the goal of general and professional education.

M.I. Makhmutov analyzed the principle of professional orientation and gave the following definition: the principle of professional orientation of education "in the specific use of pedagogical tools, it ensures that students acquire the knowledge, skills and qualifications provided for in the programs. successfully develops the attitude, professional qualities of the future engineer.

Pedagogical tools that serve to implement the professional direction of education are both elements of the content of education, in particular, the nature of illustrative material to reveal the topics of the program, the methods of its composition, and some components of the techniques, methods and forms of education.

I. Ya. Lerner sees the essence of problem-based teaching in the process of solving the system of specially designed problems and problematic tasks by students, in which they acquire the experience of creative activity. It defines and reveals concepts such as "Problem Situation", "Problem" and "Problem Task". I. Ya. Lerner defined the requirements for didactic principles: instrumentality, universality, independence, necessity. According to G.I.Khudyakova, vocational guidance is a learning principle, because it satisfies all the requirements applied to the didactic principle.

As N.F. Talyzina noted, "the quality of the professional training of a specialist of any profile depends on the level of validity of three main units: the purpose of training, the content of training and the principles of training". implementation must be managed; it is impossible to develop reasonable educational goals without determining the main system of tasks that the future specialist will face. Both the language of skills and the language of typical (basic) tasks can be used in the description. Thus, describing the educational goal means providing a system of typical tasks or a system of skills (types of activities) corresponding to them.

F.I.Kaptelina, T.V.Kuchina, Yu.M.Solomentsev, L.F.Tyurin, A.V.Kirichek, A.V.Morozova, S.N.Grigorev studied the general didactic issues of training engineers. In their works, the authors analyzed the current requirements for the qualifications of engineers and proposed ways to achieve high-quality training of highly qualified specialists. These authors believe that the process of becoming a specialist is inextricably linked with the professional direction of education.

Yu.M. Solomentsev and L.F. Tyurin studied the problems of teaching and content formation of design subjects. The authors say that the formation of professional skills should begin at a young age, and students should be oriented to work in a flexible automated production system through a vocational training course.

A.V. Morozova and A.V. Kirichek study the theoretical and methodological foundations of the formation of a multi-level practice-oriented system of training engineers and emphasize that comprehensive scientific and methodical support has an important impact on the quality of the implementation of educational programs.

According to S.N.Grigorev, unilateral efforts of educational institutions, which are difficult to quickly adapt to the needs of industrial enterprises, are not enough to effectively solve the problem of training highly qualified specialists. As a solution, he proposes the creation of a competence integration center, the main purpose of which is to coordinate and manage the processes of developing the competences of technologists. This system, in his opinion, implements the concept of continuous engineering education and is able to ensure sustainable technological progress.

S.A. Tikhomirov in his research points out that the main characteristic of a specialist is the ability to solve professional problems competently and responsibly. By professional behavior, he understands a set of standard activities that together allow a professional to solve professional problems. The process of training a specialist should be structured in such a way that the educational activity corresponds to his future professional activity.

Tikhomirov S.A. in his opinion, students should pay attention to the correct choice of tasks that they solve independently, students should have certain knowledge, skills and abilities to solve any problem. Therefore, when choosing tasks, it is necessary to analyze professional tasks and build an activity model for solving them.

A.E. Eisenson's dissertation work developed the concept of a holistic approach to the development of physics in higher education. The author believes that any academic subject should have "all the signs of the future activity of a specialist". This approach is based on principles such as pre-tertiary, higher education integrity; synthesizing physical material in a professional manner; integrity of the system of organizational forms of personnel training, etc. A.E. Aizenson suggests enriching the main material with additional material, thereby putting the student in a problem situation, awakening his feelings, and strengthening the perception of the material. In his research, the author presented a teaching-methodical set consisting of a theoretical course of preparation for higher education, including tasks related to the physics course of higher educational institution and having a professional orientation; Theoretical course of preparation for OTM, theoretical and laboratory seminars, individual assignments, etc. A.E. Aizenzon demonstrated the effectiveness of the principle of practical orientation of the educational process in the practice of teaching physics at the Higher Education Institution.

In her dissertation research, G.V. Erofeeva presents the methodology of teaching physics in HEIs using information technologies, which is based on the principle of the unity of the fundamental, professional and humanitarian components of the educational process. The structure and application of this system is based on the substantive information and theoretical connections of the physics course with general and specialized subjects. He developed a methodology for creating and implementing a computer-based teaching system for conducting all types of physics classes, including independent work, a rating system for evaluating knowledge using information technologies, as well as a technology for teaching physics to students in different types of classrooms.

V.V. Larionov's dissertation research "Problematic system of teaching physics to students of Technical Higher Education Institutions" based on the use of information and communication technologies developed a problematic system of teaching physics to students of Technical Higher Education Institutions and identifying problematic situations when students' independent research is carried out in the form of educational projects in the conditions of educational and research activities. and developing the ability to find non-standard approaches to solving cognitive problems. The content and methodology of conducting problem-based practical exercises in physics using an interactive video-training system as a means of developing students' creative-adaptive abilities and imagination about the essence of the considered phenomena are presented.
A. B. Zmodyak's dissertation research emphasizes the need for continuity in the mathematical, physical and social preparation of students and suggests making connections between disciplines. The methodology of using the content of mathematical education in the physics course at the technical higher education institution, as well as the methodology of presenting a number of complex topics that are not well understood by students, and recommendations for increasing the activity of knowledge are given.

The second approach to the implementation of the principle of professional orientation of the educational process in the study of physics by students of technical higher educational institutions is related to the use of information and communication technologies in the process of

studying physics in the preparation of students of technical higher educational institutions. The third approach is based on the formation of individual skills in solving physical problems (modeling skills, skills in applying systematic analysis, methodological, research skills, etc.). Representatives of this approach are engaged in the development of didactic tools that allow them to develop their professional skills.

At the same time, the implementation of the principle of professional orientation includes the selection of the content of the educational material, focusing on the material that is more important for professional activity without violating the unique nature of physics, and the development of methods of organizing students' activities in learning the educational material.

We analyze the foreign practice of training engineers. The global academic and research community, using various associations, is currently striving to develop a common approach to improving the quality of engineering education. Thus, in 2000, in response to employers' frustration that engineering education in the US was drifting away from practice, the Community for Engineering Education Reform Initiative—the World CDIO Initiative—emerged. The main idea of this project is to teach students based on the life cycle of real systems, processes and products, based on the principle of "Think - design - implement - manage" [58]. Future engineers should learn to manage technological processes, design and create various products and systems, and apply the acquired knowledge in their professional activities while studying at the Higher Education Institution. To date, CDIO covers more than 100 HEIs of the world, including Leeds and Bristol (UK), Massachusetts Institute of Technology, California and Stanford HEIs (USA), Sydney HEI (Australia), Chalmers HEI of Technology.

A strong material and technical base with all the necessary equipment for all specialties is required for effective educational process. In this regard, many higher education institutions are obliged to cooperate with institutes of the Academy of Sciences, network research institutes or industrial enterprises. These collaborations take many forms - collective access centers, including supercomputers, nanotechnology centers, remote access laboratories, budget and contract research projects. One of the most effective forms of integration of science and education is the establishment of basic departments at enterprises and scientific laboratories of research institutes at HEIs. In addition, in the development of any educational program, HEIs should rely on relevant priorities and a set of requirements for specialists in the modernization of the country's economy.

Thus, today there are many approaches to the implementation of the principle of professional orientation of the educational process, and their analysis allowed us to determine that:

- the main part of the work is devoted to the development of various methods of implementing the principle of vocational guidance by introducing production technologies based on physical knowledge into the lecture material; description of the principle of operation of devices and technical objects; solve physical problems with professional content; development of laboratory workshops using professional equipment; creating tasks for independent and research work with professional applications;

- there are works devoted to the formation of certain skills and qualifications necessary for the performance of professional tasks among students of technical higher education institutions (modeling, research and methodological skills, etc.);

- implementation of design and technological activities of bachelors of specific technical directions of education in solving the system of professionally oriented tasks, which are logically interrelated among the conducted studies.

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